Activities at EOC within the Bavarian Forest National Park

Stefanie Holzwarth

Nicole Pinnel

Uta Heiden

History

- Keil, M. et al (1992) *The National Parks of Bavarian Forest and Sumava - A Landsat TM Perspective on the Structure an Dynamics of the Largest Woodland of Central Europe*. European International Space Year Conference
- Keil, M. et al (1999) *Use of SIR-C / X-SAR and Landsat TM Data for Vegetation Mapping in the Bavarian Forest National Park and in the Ore Mountains.* In: Proceedings IGARSS`99
- Bordon, D. et al (2000) *Vegetations- und Totholzklassifizierung im Nationalpark Bayerischer Wald anhand von IRS-1C Daten.* Petermanns Geographische Mitteilungen - Zeitschrift für Geo- und Umweltwissenschaften

Publications (since 2015)

Journals

- Shi, Yifang et al (2018) Tree species classification using plant functional traits from LiDAR and hyperspectral data. International Journal of Applied Earth Observation and Geoinformation
- Wang, Zhihui et al (2016) Vegetation Indices for Mapping Canopy Foliar Nitrogen in a Mixed Temperate Forest. Remote Sensing
- Ali, A.M. et al (2016) Retrieval of forest leaf functional traits from HySpex imagery using radiative transfer models and continuous wavelet analysis. ISPRS Journal of Photogrammetry and Remote Sensing
- Ali, A.M. et al (2016) Estimating leaf functional traits by inversion of PROSPECT: Assessing leaf dry matter content and specific leaf area in mixed mountainous forest. International Journal of Applied Earth Observation and Geoinformation

Master Thesis

- (Rosenberger, Simon (2018) Innerartliche spektrale Variabilität ausgewählter Baumarten im Nationalpark Bayerischer Wald.)
- Fetik, Yannic Timothy (2017) Supervised machine learning of fullcube hyperspectral data.
- Sommer, Carolin (2015) Feature based tree sepcies classification using airborne hyperspectral and LiDAR data for the Bavarian Forerst National Park.

Conferences and Workshops

- Holzwarth, Stefanie et al (2018) Optimized Processing of Airborne Hyperspectral Data for Forest Studies. WHISPERS 2018
- Pinnel, Nicole et al (2017) Tree Species Classification in the Bavarian Forest National Park using Hyperspectral Remote Sensing and Site Specific Information. 10th EARSeL SIG Imaging Spectroscopy Workshop
- Heiden, Uta et al (2016) Laboratory for Essential Biodiversity Variables (EBV) Concepts – The “Data Pool Initiative for the Bohemian Forest Ecosystem”. Living Planet Symposium 2016
- Holzwarth, Stefanie et al (2015) Identifying Tree Species in the Bavarian Forest National Park. Workshop on hyperspectral imaging and LiDAR
- Leutner, Benjamin et al (2015) Sensor requirements for biodiversity research. The role of spatial and spectral resolution in mapping habitat of zoological communities. The 36th International Symposium on Remote Sensing of Environment (ISRSE)
- Sommer, Carolin et al (2015) Development of a Spectral, Structural and Site Specific Feature Data Base for Mapping of Tree Species in the Bavarian Forest National Park. 9th EARSeL SIG-Imaging Spectroscopy
- Sommer, Carolin et al (2015) Merkmalsbasierte Baumartenklassifikation mit flugzeuggestützten Hyperspektral- und LiDAR-Daten für den Nationalpark Bayerischer Wald. Der gepixelte Wald – Reloaded

EUFAR Summer School RS4forestEBV

Airborne Remote Sensing for Monitoring Essential Biodiversity Variables in Forest Ecosystem

- 3rd -14th of July 2017 in the Bavarian Forest National Park and at DLR OP
- 19 young scientists from 15 nationalities
- Coordinated by ITC
- Field measurements and airborne campaign

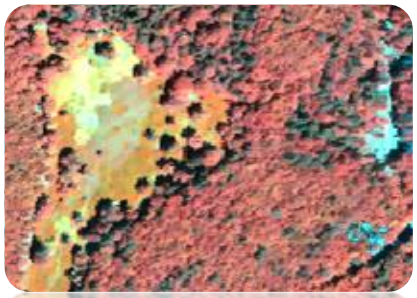
Reports and pictures available via www.eufar.net

March 2, 2018, 14:28

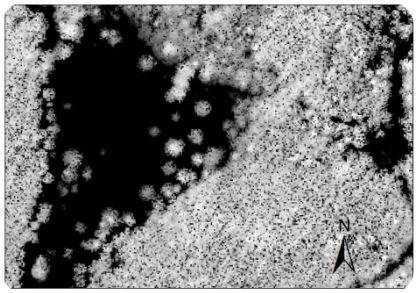
RS4forestEBV Training Course and Flight Campaign: Scientific Report

RS4ForestEBV Training Course - Airborne remote sensing for monitoring essential biodiversity variables in forest ecosystems Bavarian Forest National Park and DLR the German Aerospace...

Data Pool Initiative for the Bohemian Forest Ecosystem

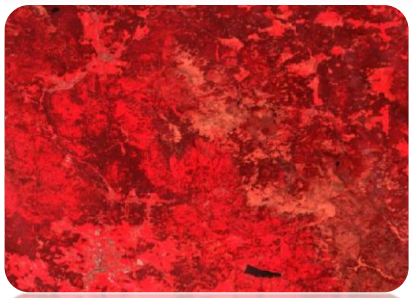


HySpex



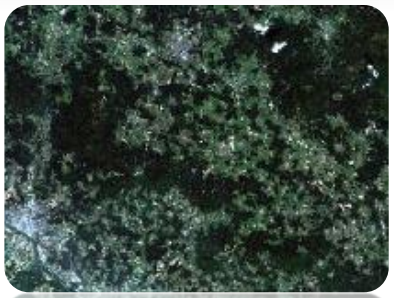
LiDAR

Aerial photos

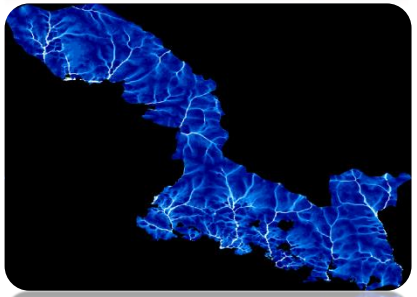


SPOT5

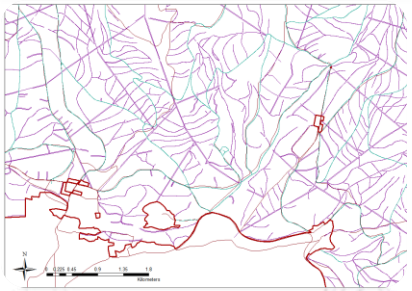
TerraSAR-X



Sentinel-2

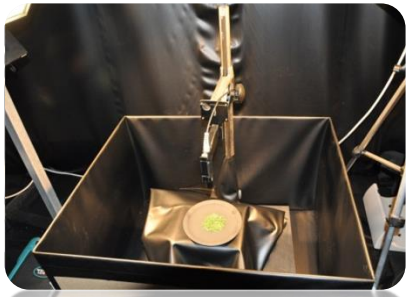


Meteo data



GIS

In-situ



Laboratory

Partner:

Nationalpark Bayerischer Wald

Národní park - Chráněná krajinná oblast Šumava

DLR

ITC University of Twente.

CzechGlobe

Přírodovědecká fakulta Faculty of Science

Jihočeská univerzita v Českých Budějovicích University of South Bohemia in České Budějovice

Technische Universität München

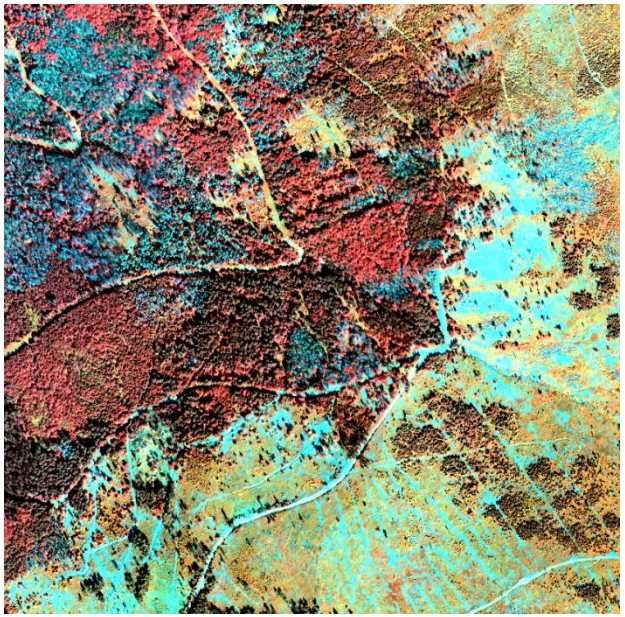
Hochschule für angewandte Wissenschaften München

Julius-Maximilians-Universität Würzburg

DLR

Imaging Spectroscopy for Forest Ecosystems

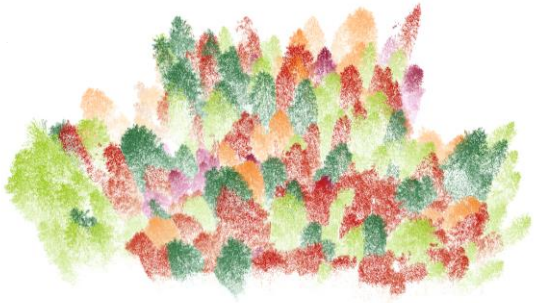
Airborne hyperspectral HySpex image (807/597/470 nm)



Heterogenity and ecological diversity in the Bavarian Forest National Park

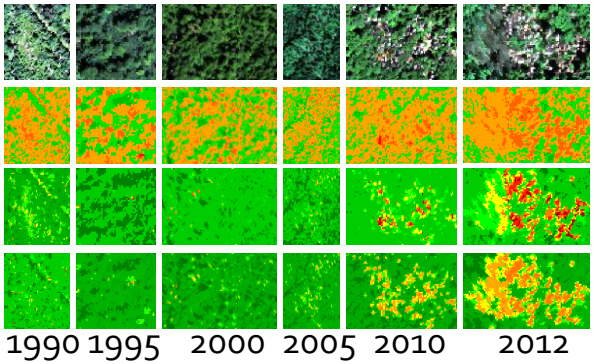
Optimized Processing of Airborne Hyperspectral Data for Forest Studies

Tree species identification using hyperspectral and LiDAR data

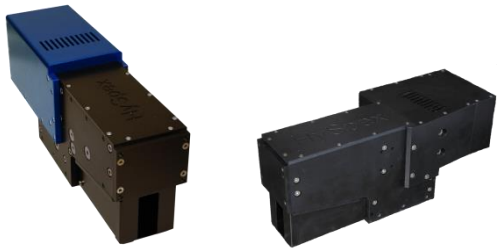


[Shi et al 2018]
- Beech
- Birch
- Fir
- Marple
- Spruce

Deadwood monitoring using spectral indices

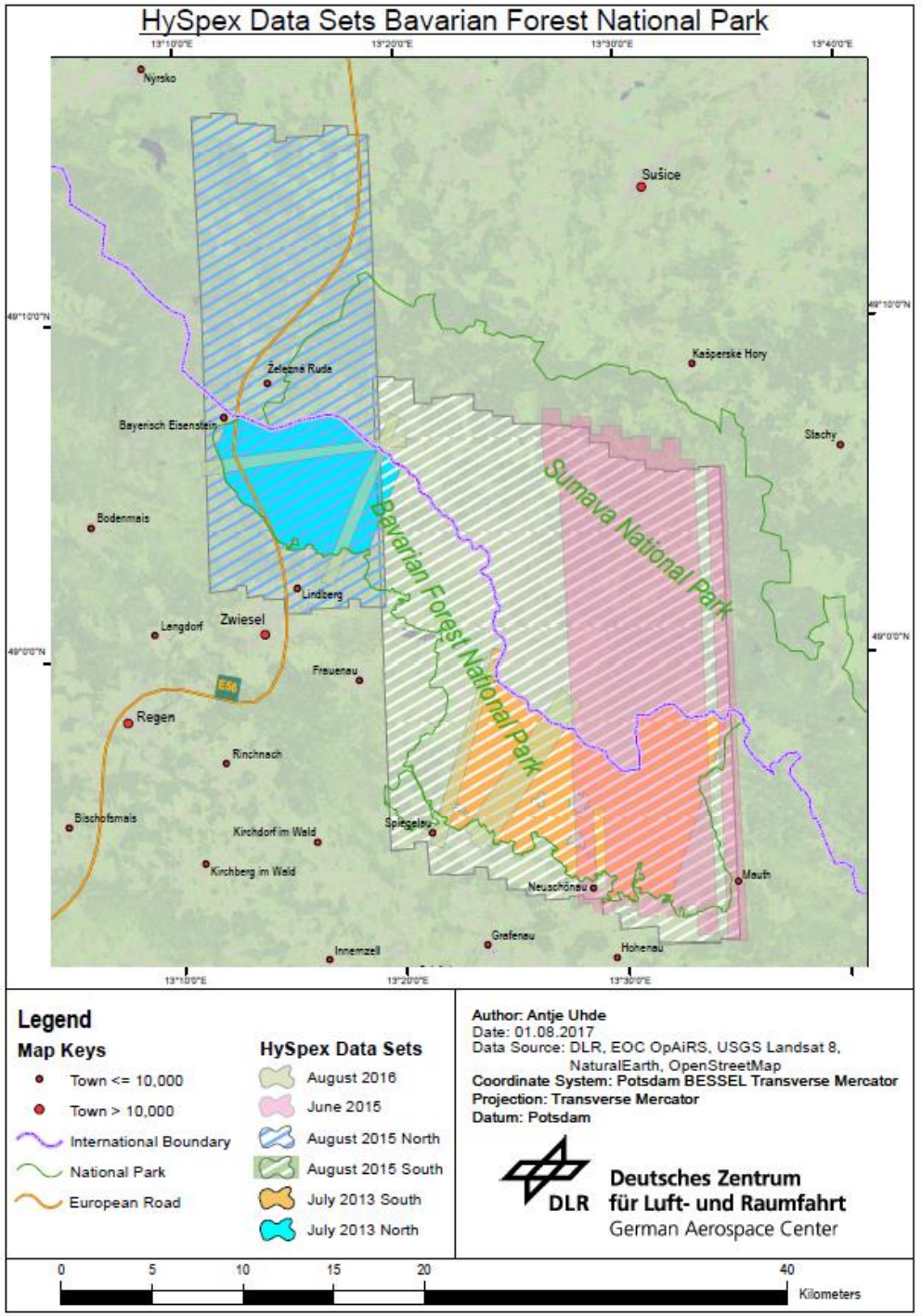


Airborne Hyperspectral HySpex Data

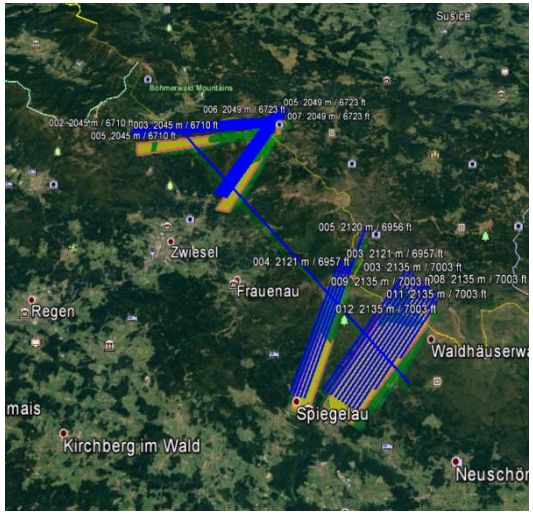


Parameter	VNIR 1600	SWIR 320m-e
Spectral range [nm]	416-992	968-2498
Spectral channels [#]	160	256
Sampling interval [nm]	3.6	6.0
Spatial resolution pixels [#]	1600	320

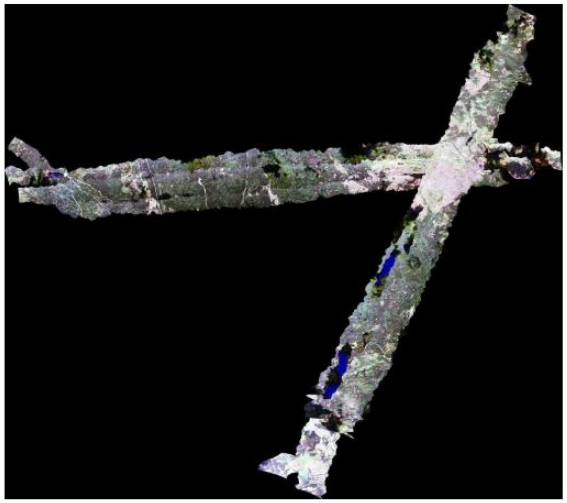
Year	Resolution	Coverage
2013	3.2m	Falkenstein and Lusen area
2015	4m	National Park
2016	2m	Transects

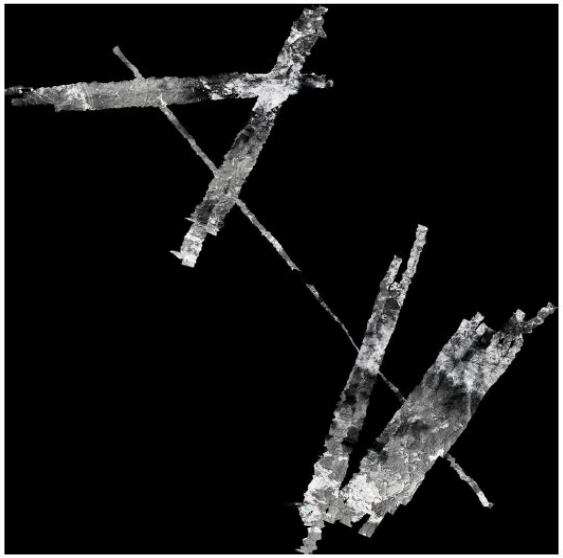


EUFAR Summer School
Airborne Data

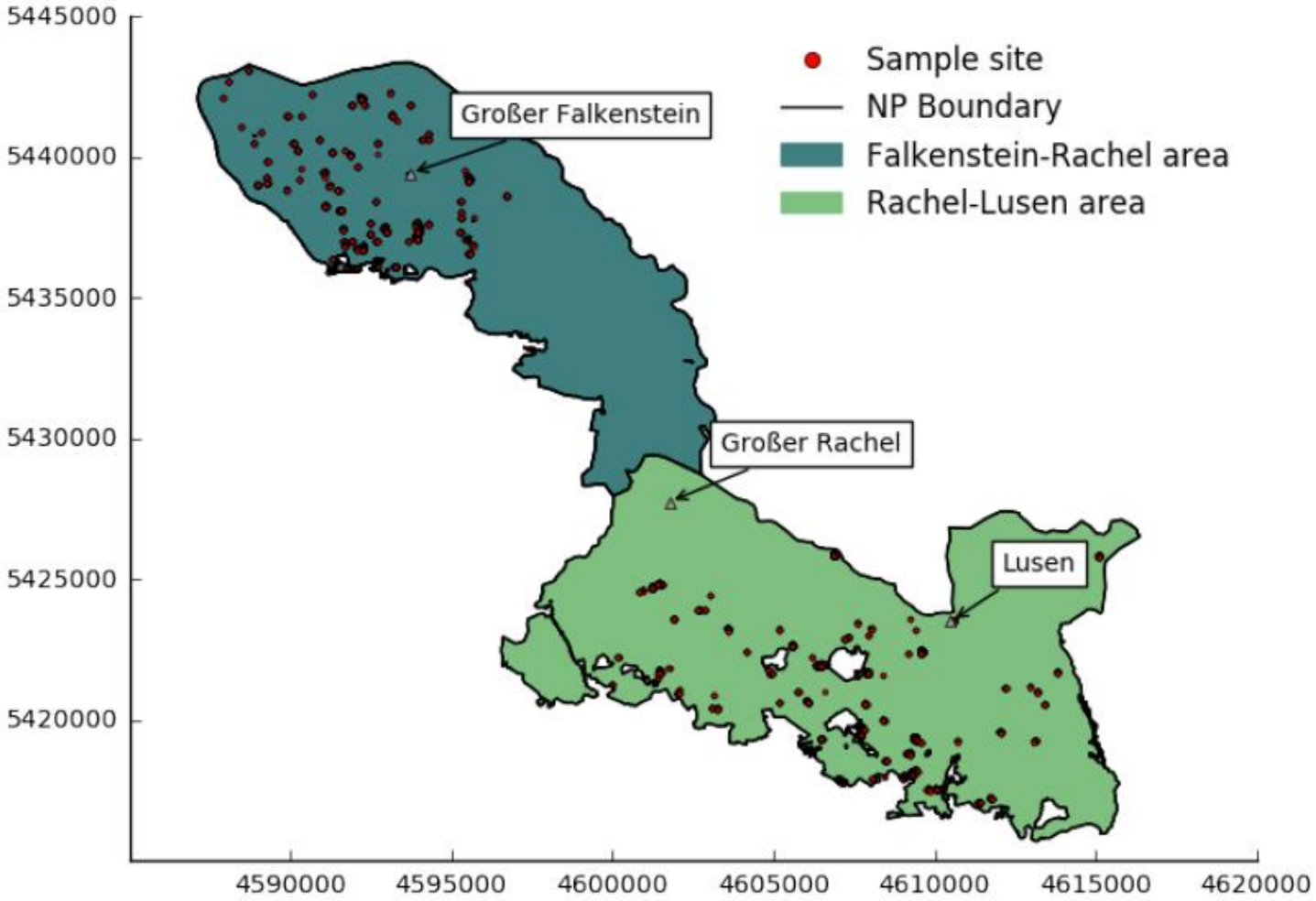


- Acquired 6th of July 2017
- 30 flightlines Aisa Fenix
- 30 flightlines Aisa Owl
- Data online available via http://data.ceda.ac.uk/badc/eufar/data/projects/rs4forestebv-a/

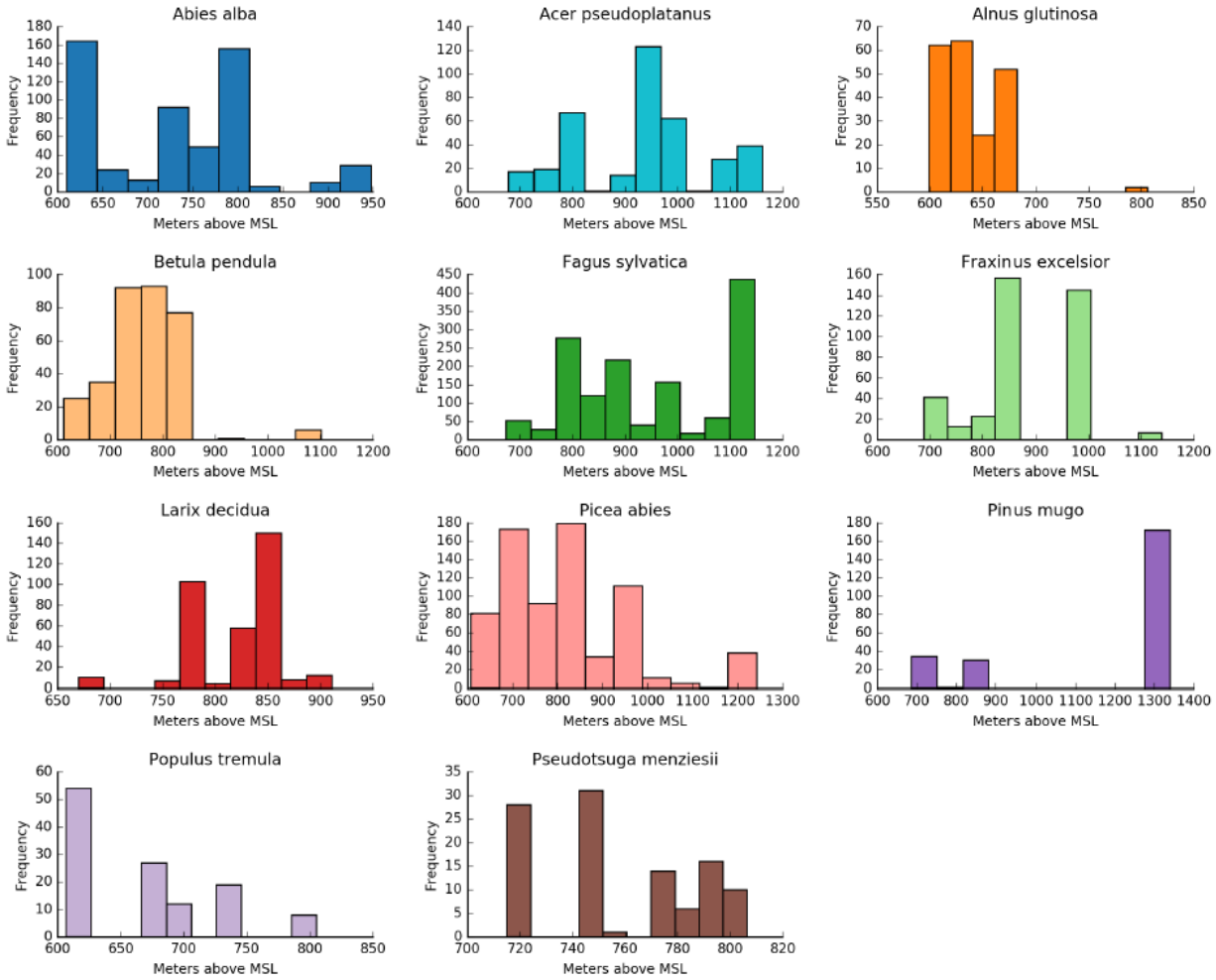




Field Data – Tree Species

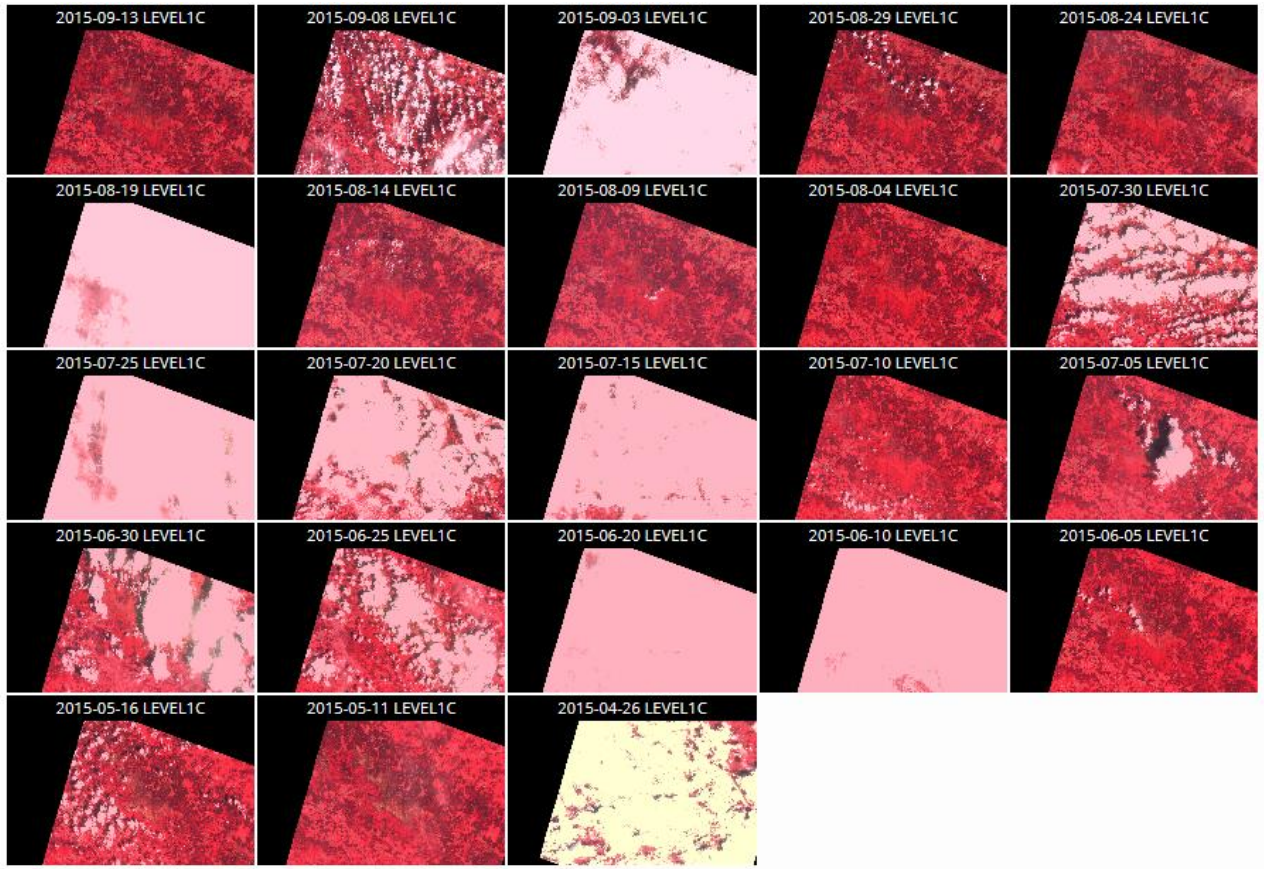


Height Distribution for Training Data

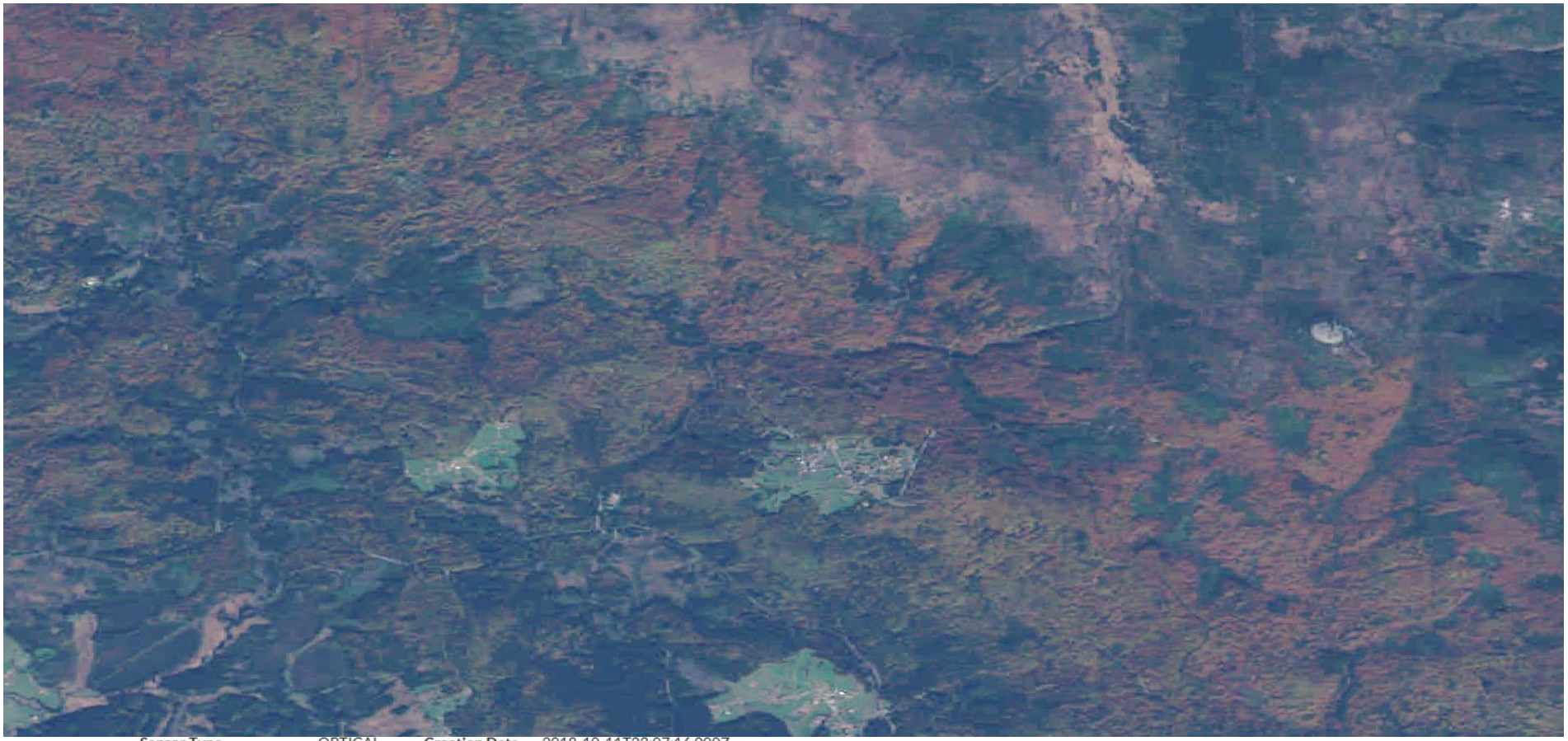


SPOT-5 Data 2015

Date	Quality
26.04.2015	
11.05.2015	
16.05.2015	
05.06.2015	
10.06.2015	
20.06.2015	
25.06.2015	
30.06.2015	
05.07.2015	
10.07.2015	
15.07.2015	
20.07.2015	
25.07.2015	
30.07.2015	
04.08.2015	
09.08.2015	
14.08.2015	
19.08.2015	
24.08.2015	
29.08.2015	
03.09.2015	
08.09.2015	
13.09.2015	



Sentinel-Data



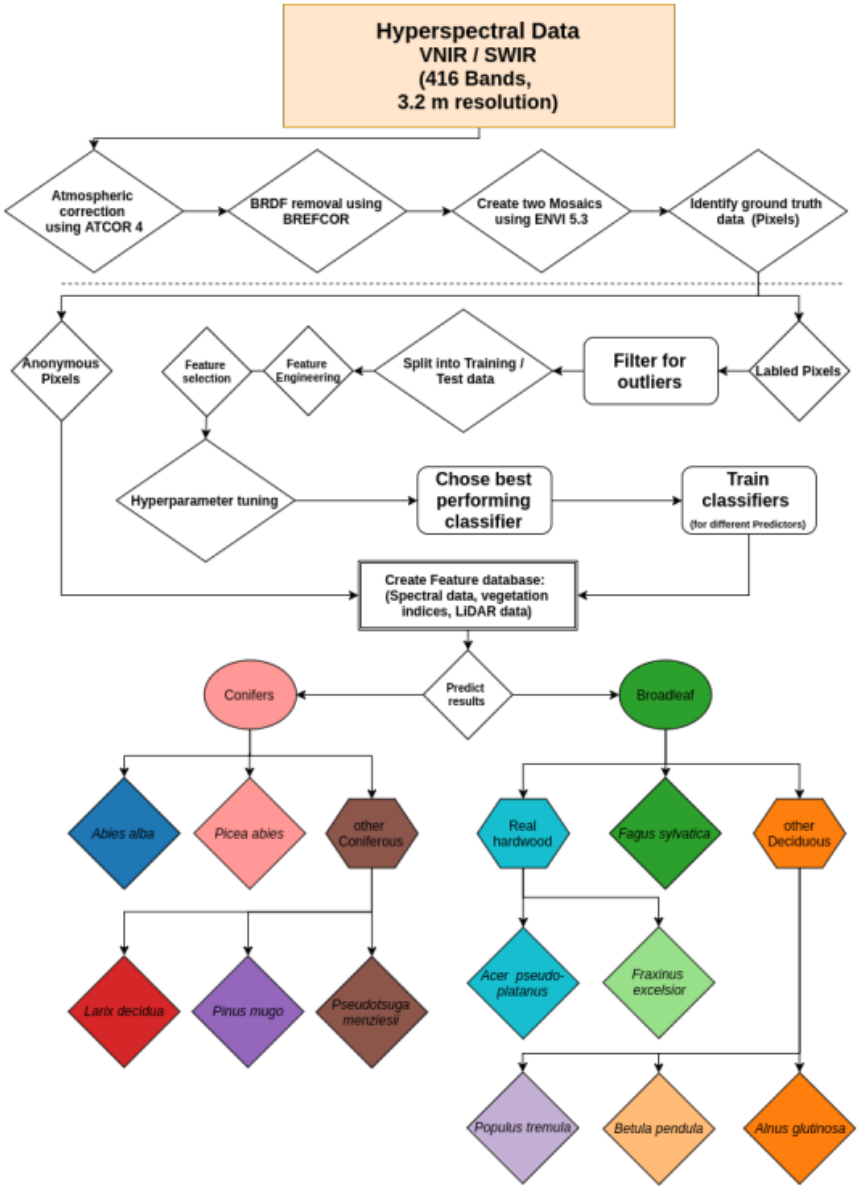
Sensor Type	OPTICAL	**Creation Date**	2018-10-11T23:07:16.000Z
Sensor Resolution	10.0	**Cloud Coverage**	0.0 %
Media Type	**ATOM | SRU**	**Download Size**	791.95MB
Metadata	**O&M**	**Access Status**	ONLINE

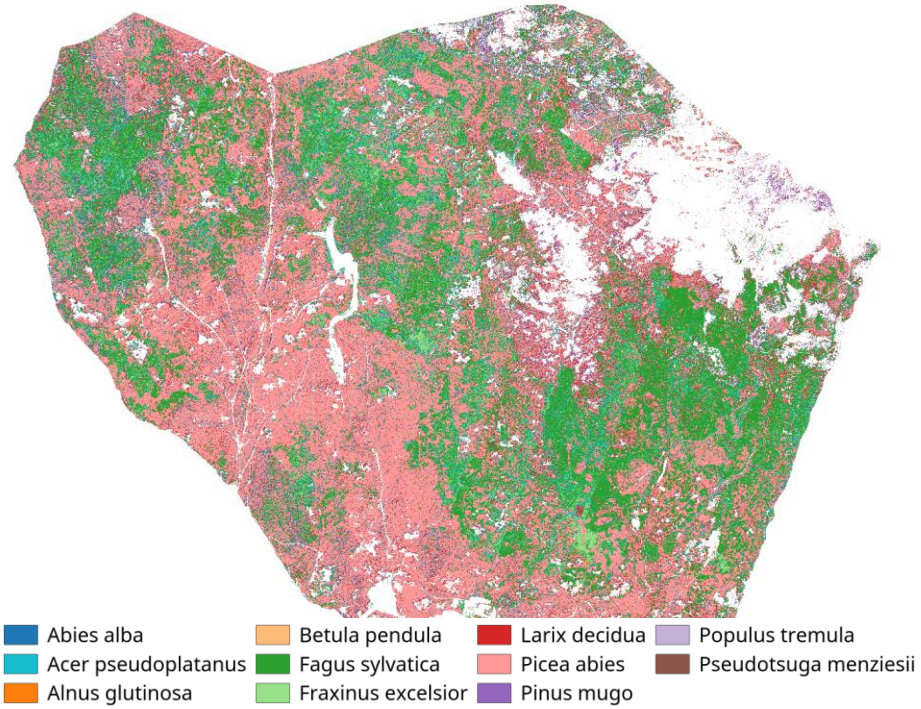
Supervised Machine Learning of Hyperspectral Data
Extremely randomized trees for classification of tree species

Master Thesis of Yannic Fetik, May 2017
Department of Geoinformatics, University of Salzburg

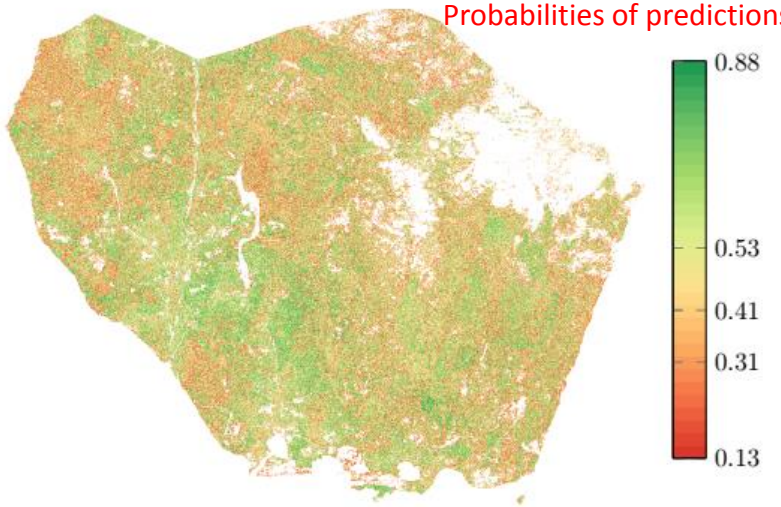
- Three different levels of complexity as basis for the classification: conifers / broadleaf, species groups, species
- Highest scores (Kappa, F1) were consistently obtained using the SWIR spectrum + VIs + LiDAR data
- Classifiers including the SWIR spectrum showed a higher ability of classifying specific species, such as abies alba (fir), fraxinus excelsior (ash) and picea abies (spruce) as opposed to those classifiers that used the VNIR spectrum only
- Shadow pixels, remaining BRDF effects, over-fitting of single features (e.g. DTM) need to be taking into account when interpreting the results
  → highest score for the model does not necessarily imply a good representation of the reality

https://elib.dlr.de/115728/1/2017-05-01_Masterarbeit_YannicFetik_final.pdf



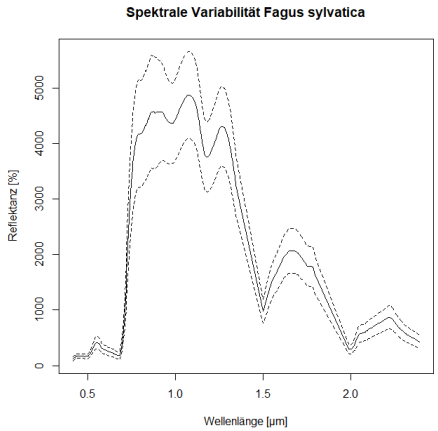


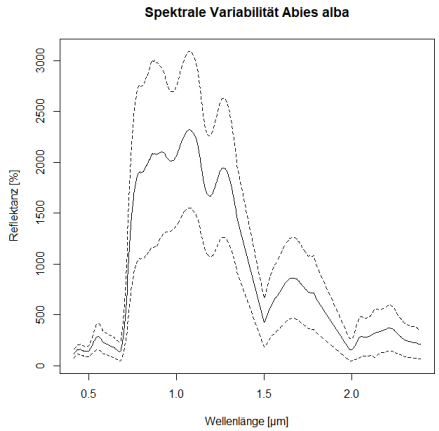
Probabilities of predictions

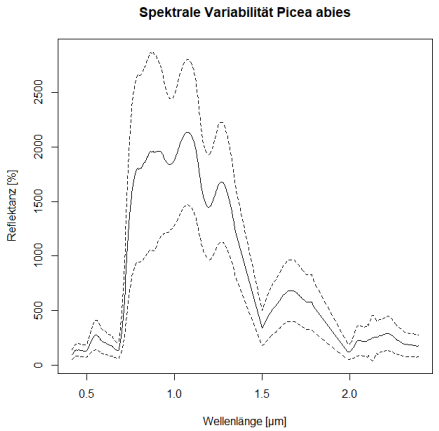


Intra-class spectral variability of tree species induced by topography and environmental parameters

Master Thesis of Simon Rosenberger, July 2018
Department of Geography, FAU Erlangen-Nürnberg







- consideration of different indices (carotenoid, nitrogen, moisture stress, canopy scale concentration,…)
- topographic parameters: elevation, slope, aspect, topographic position index

→ a big portion of the spectral variability can be explained with the difference in easting and northing

Future Ideas

- Include multi-seasonal classification approach for tree species
  → combination of airborne and satellite data
- Improve co-registration of LiDAR and hyperspectral data
  → improve object based approach
- Enlarge training data according to the findings of the different master thesis

- …